Oct. 31, 1933. G. E. JANSSON 1,933,175

ELECTRIC SWITCH HAVING MAGNETIC ARC EXTINGUISHING MEANS

Filed Feb. 27, 1931

Fig. 1.

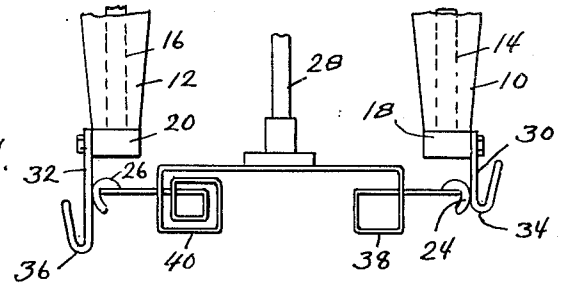


Fig. 2.

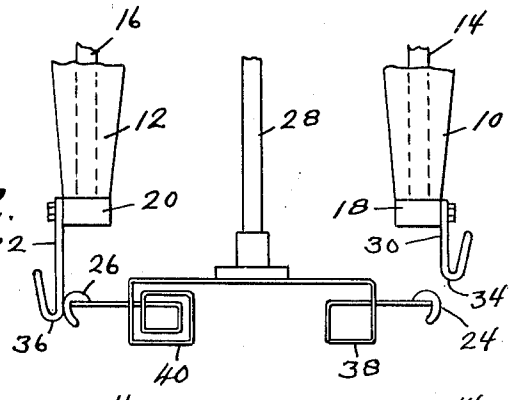
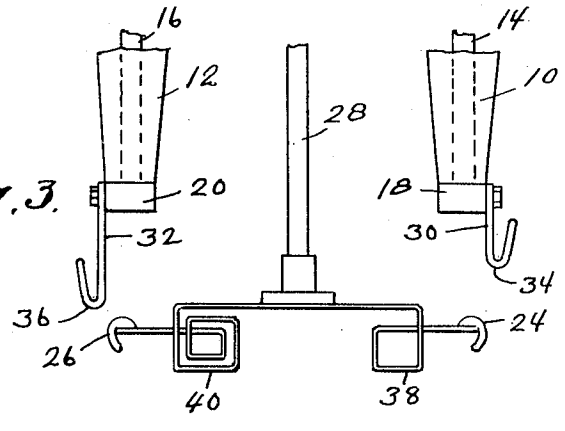


Fig. 3.



Inventor.
Gustav E. Jansson
by [illegible]
Atty

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ELECTRIC SWITCH HAVING MAGNETIC ARC EXTINGUISHING MEANS

Gustav E. Jansson, Atlantic, Mass., assignor to Condit Electrical Manufacturing Company, Hyde Park, Mass., a corporation of Massachusetts

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18 Claims. (Cl. 200—147)

This invention relates to multi-break electric switches and contact structures therefor, and particularly to heavy duty switches, usually of the oil immersed type, having an arrangement of contact members and associated conducting components by which the current traversing the switch circuit is caused to act electromagnetically on the circuit interrupting arcs drawn between the separated contact members to urge the arcs laterally away from the contact members and to attenuate the arcs rapidly independently of the separation of the contact members and to cause the arcs to be forced against the cold body of oil surrounding the arc zones, thus to cool and effect a quick extinguishment of the arcs.

There is a definite limit to the magnitude of the blow-out effect which can be advantageously provided in a switch of given dimensions and arrangement of parts to extinguish the arcs since, amongst other reasons, if the reaction between the blow-out flux and the arc is too pronounced, the arcs are frequently caused to strike over to the grounded switch casing. On the other hand, if the blow-out effect is too weak, the arc persists for a relatively long time. Thus, if the magnetic blow-out flux is strong enough to extinguish a low current arc rapidly it is too strong for a high current arc and, oppositely, if the flux is suitable for a high current arc it is too weak for a low current arc.

It is an object of this invention to provide an arrangement of contact members and associated current conducting components for an electric switch in which about the same effective blow out effect is available for arc elongation and extinguishment at the time of circuit interruption for both high and low current values.

A further object of the invention is the provision of a switch having means whereby a blow-out conductor is provided for setting up a magnetic flux for diverting the circuit interrupting arc and wherein the number of convolutions of said conductor is less for interrupting a high current arc than for interrupting a low current arc.

A further object of the invention is the provision of a multi-break electric switch having two sets of separable contact members in series, one of which sets separates first, and having current conducting loops included in the circuit through said contact members one of which is located adjacent each set of contact members whereby to exert an electromagnetic effect on the arcs, the loops adjacent said set of contact members last to separate having more turns and thus a greater magnetic effect than the loop adjacent the contacts first to separate; and more specifically to provide a current conducting loop adjacent the contacts last to separate having a greater ampere turn capacity than the loop adjacent the initially separated contact members, whereby heavy current arcs will be interrupted at the contacts first to separate and light current arcs which persist will be interrupted at the second set of contact members due to the increased magnetic blow-out effect provided by the multiple turns thereof.

A further object is generally to improve the construction and performance of electric switches.

Fig. 1 is a diagrammatic representation of the invention as applied to a two break electric switch.

Figs. 2 and 3 are views similar to Fig. 1 with the parts in different positions.

The invention is illustrated in connection with a two break oil immersed electric switch, only those parts of the switch being shown which are necessary for an understanding of the invention. It will be understood that the invention is applicable to switches having a larger number of points of circuit interruption and that it is not limited in its application to switches of the oil immersed type.

As herein shown the switch embodying the invention includes a pair of spaced stationary switch members including the vertical insulating bushings 10 and 12 and the axial conducting studs 14 and 16 which terminate at their lower ends beneath the level of the oil in the switch receptacle (not shown) in contact blocks 18 and 20.

The movable switch member includes a generally horizontal bridging member which is also a conductor and which terminates at its opposite ends in the movable contact members 24 and 26 and is vertically movable by means of the insulating rod 28 into and out of bridging engagement with contact faces 30 and 32 of cooperating stationary contact members 34 and 36 which are carried by and depend from the contact blocks 18 and 20 respectively. The movable bridging member is further provided at its opposite ends adjacent the contact members thereof with current conducting loops or convolutions 38 and 40, the turns of which are arranged in a now well known manner to provide an electromagnetic field in the vicinity of the

arc zone between the separated contact members which acts upon the arc between the contact members to urge it laterally and outwardly away from the contact members and into contact with cool bodies of insulating oil, whereby quickly to effect its extinguishment. It is the specific purpose of this invention to provide electromagnetic means at one point of circuit interruption, as at the cooperating contact members 24, 34, designed to act upon a high current arc to quickly extinguish it, preferably at the first current zero following the separation of the contact members; and to provide electromagnetic means associated with the other cooperating set of contact members 26, 36, which is operable only after the contact members 24, 34, have separated a sufficient distance normally to have interrupted an arc drawn therebetween, designed to act effectively upon a circuit interrupting arc of relatively low current value to interrupt it, preferably at the first current zero following the separation of said last contact members. To this end the stationary contact member 36 is elongated whereby to provide a long contact face 32 thereon which remains in engagement with the cooperating contact member 26 for a sufficient time to permit the contact member 24 to separate a substantial distance from its cooperating contact member 34, as shown in Fig. 2, whereby to draw a circuit interrupting arc therebetween. Further movement of the movable switch member into the position shown in Fig. 3 serves to separate the contact members 26, 36.

Also in accordance with this invention the loop 38 associated with the contacts first to separate is designed to set up a relatively weak magnetic field in the arc zone between the contact members 24, 34, and to this end, comprises a single convolution. The loop 40 associated with the contacts last to separate is designed to set up a relatively high magnetic field in the arc zone between the contact members 26, 36, and to this end, comprises a plurality of, and as here shown, two convolutions.

The operation of the switch as above described is essentially as follows:

When the switch begins to open, the contact members 24, 34 are the first to separate and an arc is drawn between them while the other contact members 26, 36 are yet in engagement. The arc is thus acted on by the magnetic field produced by the loop 38 and is diverted away from the separated contact members and also is elongated and the ends thereof are forced apart by moving up and down the stationary and movable contact members respectively. If the arc current is high the reaction between the field and the arc is highly effective and causes the arc to go out at the time of the first current zero following the separation of the contact members. The magnetic field produced by the single turn of the loop, while strong enough to perform effectively, as above described, yet is weak enough to prevent driving the arc into contact with the side walls of the enclosing casing, not shown, and also to prevent an unnecessary amount of gases being generated. If, however, the current traversing the switch, the loop and the arc is moderate, the magnetic field produced by the single turn loop 38 is not effective in extinguishing the arc at the first current zero. Consequently the arc persists. Due to continued separating movement of the switch, however, the second set of contact members 26, 36, now separate and an arc is drawn therebetween in series with the first arc. This second arc is acted upon by the strong magnetic field produced by the multi-turn loop 40 and is rapidly and strongly diverted and extended and thus is caused to go out at the first current zero following contact separation.

Thus, if the arc current is high the current will be interrupted at the first separated contact members and, if the current is low, the effective circuit interruption will take place at the second separated contact members.

With sufficiently strong magnetic fields at both sets of contact members, a low current arc can be interrupted in one cycle and a high current at one-half cycle after the initiation of the arc, without danger of contact between the arc and other parts of the switch.

This arrangement is considered to be particularly desirable for interrupting low currents as the strong magnetic field acts only on the low current arcs.

While the arrangement here shown for accomplishing the intended results is the preferred form of the invention for most purposes, it will be apparent that the invention may be modified otherwise to obtain a strong blow-out field for low currents and a high blow-out field for high currents.

I claim:

1. In an electric switch, the combination of two serially connected sets of separable contact members, one of which sets is arranged to separate first, and means located adjacent said contact members in position to set up magnetic fields of different densities which influence the arcs drawn therebetween, said contact members last to separate being located in a field of relatively great flux density and said contact members first to separate in a field of lesser density.

2. In an electric switch, the combination of two serially connected sets of separable circuit interrupting contact members, one of which sets is arranged to separate first, and electromagnetic means energized by the current traversing the circuit including said contact members arranged to set up magnetic fields of different densities for the same circuit current which act to displace the circuit interrupting arcs drawn between said contact members, said contact members last to separate being located in a region of relatively great flux density and said contact members first to separate being located in a region of lesser flux density.

3. In an electric switch, the combination of two serially connected sets of separable circuit interrupting contact members, one of which sets is arranged to separate first, and means associated with said contact members and constituting a part of the electrical circuit through the switch arranged to set up electromagnetic fields of different densities in the vicinity of the circuit interrupting arcs drawn between said contact members and having its region of greatest flux density located in the vicinity of said contact members last to separate.

4. In an electric switch, the combination of two sets of separable contact members included in series in the circuit through the switch, one of which sets is arranged to be separated first, and electromagnetic means associated with said contact members first to separate effectively responsive mainly to a high current value to displace the circuit interrupting arc drawn therebetween, and electromagnetic means associated

with said contact members last to separate effectively responsive to a low current value to displace the arc drawn therebetween.

5. In an electric switch, the combination of two sets of separable contact members included in series in the circuit through the switch, one of which sets is arranged to be separated first, and current conducting loops of differing turns located adjacent and in series with said sets of separable contact members and traversed by the current flowing in the switch current, the loop having the greater number of turns being located adjacent the contact members last to separate.

6. In an electric switch, the combination of a plurality of sets of serially connected contact members, means for separating the contact members of the sets in successive order, and means constituting a part of the current conducting path through the switch arranged to set up electromagnetic fields in the vicinity of said sets of separable contact members, which fields are of different intensity for each set of contact members and for the same arc current.

7. In an electric switch, the combination of two spaced stationary contact members, a movable conducting member having contact members at its opposite ends arranged to engage said stationary contact members, whereby to complete the circuit through the switch, means to separate said pairs of cooperating stationary and movable contact members successively, and electromagnetic means including current conducting loops of differing numbers of turns included in the current path through the switch for influencing separately the circuit interrupting arcs drawn between said contact members.

8. In an electric switch, the combination of two sets of separable contact members included in series in the switch circuit, one of which sets separates first, electromagnetic means located adjacent the contact members first to separate in position to extinguish the arc drawn therebetween when a heavy current traverses the switch circuit, said electromagnetic means adapted to be too weak to extinguish a low current arc, and electromagnetic means located adjacent the contact members last to separate having enhanced electromagnetic effect, whereby to extinguish a low current arc drawn therebetween.

9. In an electric switch, the combination of a pair of fixed contact members, a pair of cooperating movable contact members arranged successively to engage and disengage said fixed contact members, and means electrically connecting said movable contact members comprising a pair of current loops one of which is located adjacent each movable contact member and arranged to set up a field to influence the arc drawn thereat, the loop adjacent the movable contact member first to break having fewer turns than the loop adjacent the contact member last to break, whereby an arc due to a heavy current will be extinguished at the initial break and an arc due to a light current will be extinguished at the final break, due to the enhanced electromagnetic effect of the multi-turn loop associated therewith.

10. In an electric switch, the combination of two sets of serially connected arcing contact members, one of which sets is arranged to separate first, and means which is energized from the current traversing the switch circuit arranged to set up magnetic fields of different flux densities in the vicinity of said separable contact members which act upon the arcs drawn therebetween, said set of contact members last to separate being located in the field of greatest flux density, whereby an arc drawn therebetween is subjected to a greater magnetic blowout effect than an arc having the same current drawn between the contact members first to separate.

11. In an electric switch, the combination of a pair of spaced stationary switch members terminating in fixed contact members, a movable switch member comprising a current conducting member having cooperating movable contact members at its ends arranged to engage and bridge said fixed contact members and also to disengage said contact members successively, said conducting member having a configuration such that current traversing it is caused to set up electromagnetic fields of different strength in the vicinity of said separable contact members which act on the arcs drawn therebetween to displace the arcs in opposite directions away from said contact members, the field in the vicinity of the contact members first to separate being effective to blow out the arc only upon passage of a heavy current through said conducting member, and the field in the vicinity of said contact members last to separate having a greater flux density whereby to provide an effective blow-out at lower current values.

12. In an electric switch, the combination of two spaced stationary switch members terminating in fixed contact members, a pair of movable contact members arranged to engage and disengage said fixed contact members successively, conducting means connecting said movable contact members having a loop adjacent the movable contact member which is first to engage and a second loop which is adjacent the movable contact member last to engage said cooperating fixed contact member, said second loop having a higher magnetizing power at a given current than said first loop, whereby heavy current arcs will be interrupted at the contact members first to separate without excessive distension and low current arcs which persist will be interrupted at said contact members last to separate by reason of the enhanced magnetic strength of said second loop.

13. In an electric switch, the combination of two sets of serially connected separable contact members, one of which sets is arranged to separate first, and electromagnetic means including a coil located adjacent each of said sets of separable contact members and connected in the circuit therethrough, the coil adjacent said contacts last to separate having a greater number of turns than that adjacent the contact members first to separate.

14. In an electric switch, the combination of two serially connected sets of separable contact members, one of which sets is arranged to separate first, a current conducting coil located adjacent said contact members first to separate, a second coil located adjacent said contact members last to separate, said coils being connected electrically in the circuit through the switch, and said second coil having a greater number of turns than said first coil.

15. In an electric switch having separable arcing members, the combination therewith of magnetic means energized by the arc current for setting up the same magnetic blow-out effects on low and also on high current arcs.

16. In an electric switch having the combina-

tion of sets of separable contact members, the combination therewith of magnetic means which extinguishes low current arcs at one set of contact members and high current arcs at another set of contact members.

17. In an electric switch having the combination of sets of separable contact members, the combination therewith of magnetic means responsive to the strength of the arc current for extinguishing low current arcs at one set of contact members and high current arcs at another set of contact members.

18. An electric switch having two sets of separable contact members in series at which circuit interrupting arcs are adapted to be drawn, and arc extinguishing means associated with each set of contact members, the arc extinguishing means of one set of contact members being most effective to interrupt the arc therebetween under one circuit condition and the arc extinguishing means of the other set of contact members being most effective to interrupt the arc therebetween under a different circuit condition.

GUSTAV E. JANSSON.

CERTIFICATE OF CORRECTION.

Patent No. 1,933,175. **October 31, 1933.**

GUSTAV E. JANSSON.

It is hereby certified that the name of the assignee in the above numbered patent was erroneously described and specified as "Condit Electrical Manufacturing Company" whereas said name should have been described and specified as Condit Electrical Manufacturing Corporation, as shown by the records of assignments in this office; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of December, A. D. 1933.

F. M. Hopkins

(Seal) Acting Commissioner of Patents.